Communication Technology

YEAR 5-9
PHYSICAL SCIENCES
DESIGN AND TECHNOLOGIES
MATHEMATICS

QGC | FUTUREMAKERS | QUEENSLAND MUSEUM NETWORK | Queensland Government

Future Makers

Future Makers is an innovative partnership between Queensland Museum Network and Shell's QGC business aiming to increase awareness and understanding of the value of science, technology, engineering and maths (STEM) education and skills in Queensland.

This partnership aims to engage and inspire people with the wonder of science, and increase the participation and performance of students in STEM-related subjects and careers — creating a highly capable workforce for the future.

Cover image: A portrait of semaphore and telescope field work. The soldier on the left holds sempahore flags in his hands. Semaphore flags were used as a daytime signalling system during the First World War. Courtesy of Australian War Memorial.

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EXPLORE – EXPLAIN – ELABORATE – EVALUATE

Communication Technology

The battlefields were dangerous places where the flow of critical information was stalled by frontline conditions. In response, communication during the war evolved dramatically; new inventions were developed while existing technologies were adapted to better suit the context of war.

In the following activities, students identify and evaluate the communication technologies used during the war. They then apply their understanding of the physical sciences to construct a telegraph machine and develop and use a cipher to send a coded message.

Activity 1: First World War Communication Technologies

Teacher Resource

Students identify and evaluate the communication technologies used during the First World War. Detailed step-by-step instructions for this activity can be seen below. It is recommended that you use these instructions to guide your students through the activity as a class.

1. Share the following statement with students:
   Communication can make or break a war.
   Ask students to respond to this statement, and to discuss what they think it means. Students may engage in a Think-Pair-Share to complete this task.
2. Inform students that they will spend time investigating and evaluating the communication technologies used during the First World War. Divide students into groups of two or three and distribute communication technology images to student groups. Provide groups with time to view and read about each communication technology.
3. Students complete a PMI chart for each communication technology (see below). They discuss and/or write down the positive, negative and interesting implications associated with use of the communication technology in the context of war. Students may also consider the ethical implications associated with the use of each communication technology.

Plus	**Minus**	**Interesting**

4. Students then evaluate the communication technologies, rating them from most effective to least effective in the context of war. Students should also be able to provide reasons to justify their decisions.
5. Students share their responses with the class group. Compare the responses of all groups. What do students notice? Are their responses very similar or very different? Why might this be the case? How could students make more informed decisions about the effectiveness of each communication technology?

Following this, you may ask students to conduct further research into each communication technology. Students use researched information to reconsider and revise their response to the previous task. Students could also investigate the development and/or invention of these communication technologies, and consider which are still in use today and why this might be the case.

Curriculum Links

Science

YEAR 5

Science as a Human Endeavour

Scientific knowledge is used to solve problems and inform personal and community decisions (ACSHE083)

YEAR 6

Science as a Human Endeavour

Scientific knowledge is used to solve problems and inform personal and community decisions (ACSHE100)

YEAR 7

Science as a Human Endeavour

Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures (ACSHE223)

Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations (ACSHE120)

People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity (ACSHE121)

YEAR 8

Science as a Human Endeavour

Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures (ACSHE226)

Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations (ACSHE135)

People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity (ACSHE136)

YEAR 9

Science as a Human Endeavour

Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries (ACSHE158)

Design and Technology

YEAR 5 AND 6

Design and Technologies: Knowledge and Understanding

Investigate characteristics and properties of a range of materials, systems, components, tools and equipment and evaluate the impact of their use (ACTDEK023)

Investigate how electrical energy can control movement, sound or light in a designed product or system (ACTDEK020)

Design and Technologies: Processes and Production Skills

Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions (ACTDEP024)

YEAR 7 AND 8

Design and Technologies: Knowledge and Understanding

Analyse how motion, force and energy are used to manipulate and control electromechanical systems when designing simple, engineered solutions (ACTDEK031)

Analyse ways to produce designed solutions through selecting and combining characteristics and properties of materials, systems, components, tools and equipment (ACTDEK034)

Design and Technologies: Processes and Production Skills

Critique needs or opportunities for designing and investigate, analyse and select from a range of materials, components, tools, equipment and processes to develop design ideas (ACTDEP035)

YEAR 9

Design and Technologies: Knowledge and Understanding

Investigate and make judgments on how the characteristics and properties of materials are combined with force, motion and energy to create engineered solutions (ACTDEK043)

Investigate and make judgments on how the characteristics and properties of materials, systems, components, tools and equipment can be combined to create designed solutions (ACTDEK046)

General Capabilities

Literacy

Comprehending texts through listening, reading and viewing

Composing texts through speaking, writing and creating

Visual knowledge

Critical and Creative Thinking

Inquiring: Identifying, exploring and organising information and ideas

Reflecting on thinking and processes

Personal and Social Capability

Social management

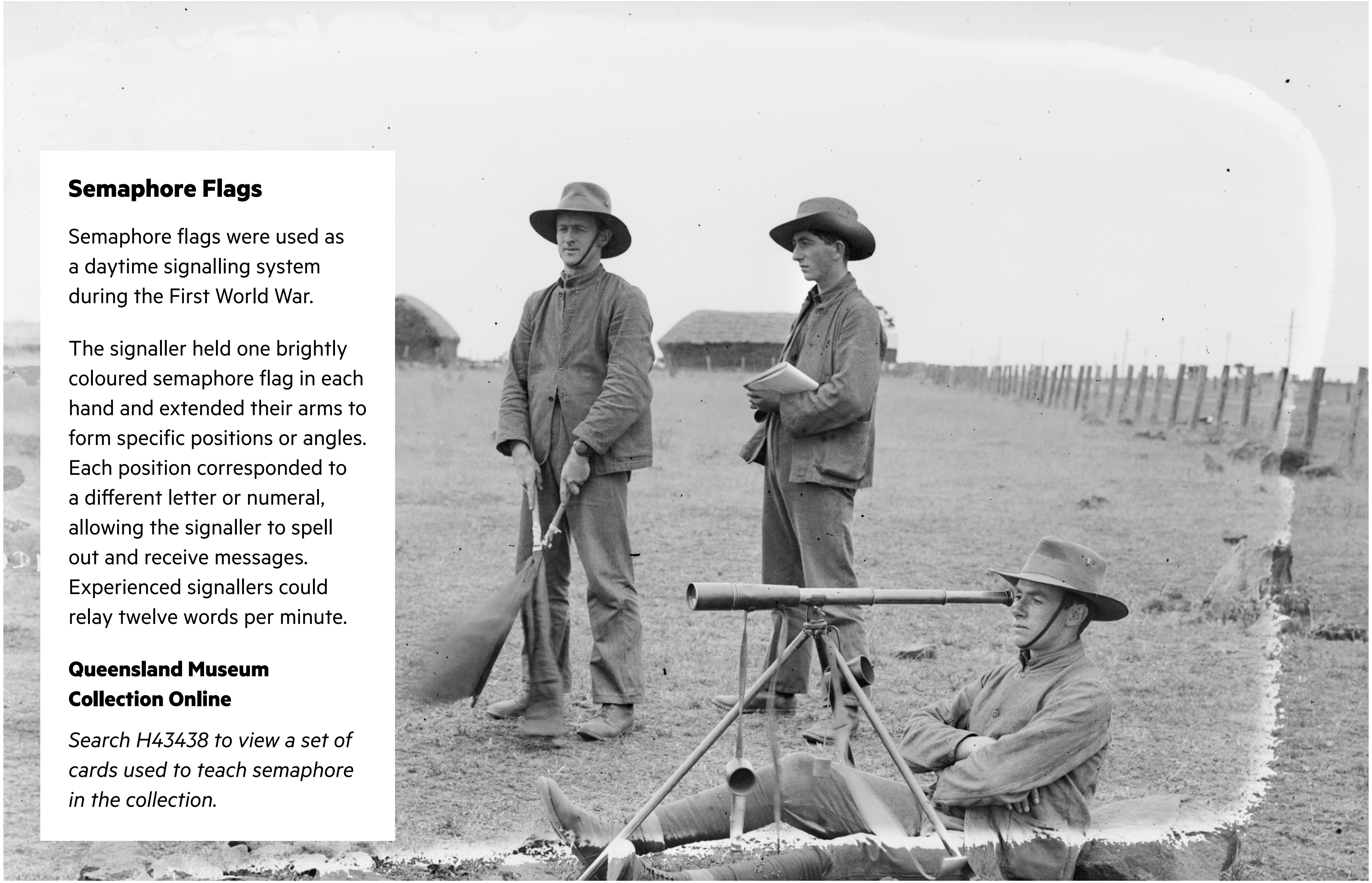
Semaphore Flags

Semaphore flags were used as a daytime signalling system during the First World War.

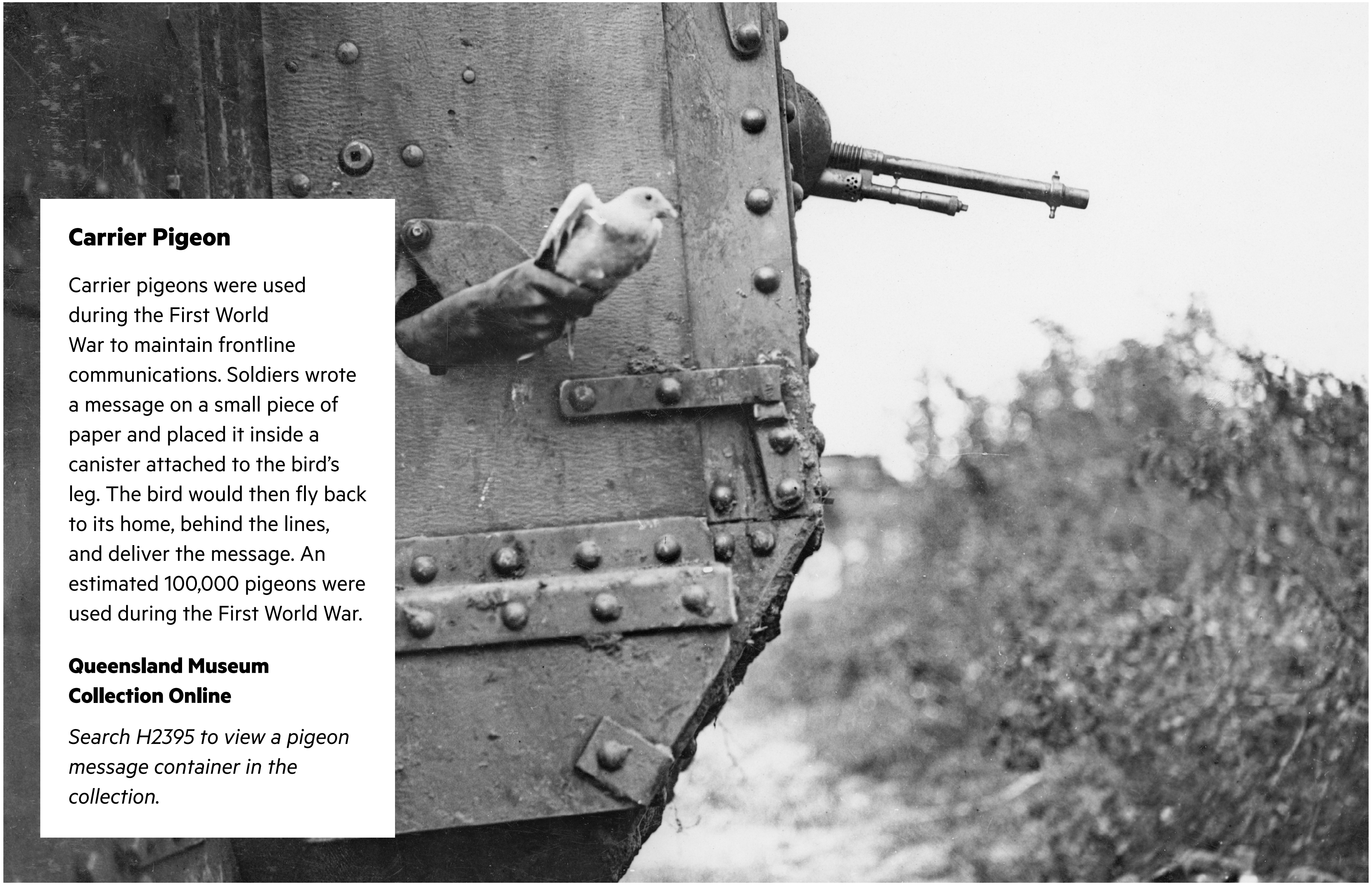
The signaller held one brightly coloured semaphore flag in each hand and extended their arms to form specific positions or angles. Each position corresponded to a different letter or numeral, allowing the signaller to spell out and receive messages. Experienced signallers could relay twelve words per minute.

Queensland Museum Collection Online

Search H43438 to view a set of cards used to teach semaphore in the collection.



Courtesy of Australian War Memorial



Carrier Pigeon

Carrier pigeons were used during the First World War to maintain frontline communications. Soldiers wrote a message on a small piece of paper and placed it inside a canister attached to the bird's leg. The bird would then fly back to its home, behind the lines, and deliver the message. An estimated 100,000 pigeons were used during the First World War.

Queensland Museum Collection Online

Search H2395 to view a pigeon message container in the collection.

Courtesy of Australian War Memorial

Courtesy of Australian War Memorial

Heliograph

The heliograph used a mirror to reflect sunlight to a distant observer. Flashes of light could be used to send Morse code by covering or moving the mirror away from the sun.

Courtesy of Australian War Memorial

Messenger Dog

Dogs were used to send and receive messages across the front line and between bases throughout the First World War. Messages were carried in a metal tube attached to the dog's collar.

Courtesy of BT Heritage

Telegraph

Telegraphs send an electric current along a cable to a receiving station. When the sender presses the telegraph key the electric current is completed. This can cause an audible sound, a lightbulb to flash or the making of marks on a piece of paper. The receiver then decodes these signals to understand the message.

Queensland Museum Collection Online

Search H9188 to view a telegraph key in the collection.

Telephone

Telephones allowed soldiers to communicate with each other across the battlefield. Telephones convert sound into electrical signals suitable for transmission via cables. These signals are received and the electric signals converted back into sound. Telephones could operate point to point or via a switchboard at a command post.

Courtesy of Australian War Memorial

First World War Communication Technologies

Student Activity

Communication Technology	Positive	Minus	Interesting

Activity 2: Construct a Telegraph Machine

Teacher Resource

"This mode of instantaneous communication must inevitably become an instrument of immense power, to be wielded for good or for evil, as it shall be properly or improperly directed."
Samuel Morse in an 1838 letter to Francis O.J. Smith

The telegraph machine was developed by Samuel Morse and other inventors in the 1830s and 1840s. The telegraph transformed how people communicated for both business and private purposes, providing a reliable and relatively fast method of transmitting information across long distances.

Telegraphs consist of a transmitter and receiver, a power source and wire cable. When the transmitter key is pressed down, the electric circuit between the transmitter, power source and receiver is completed. This produces a pulse of electricity that is sent through the wire cable to the receiver. When it reaches the receiver, the electric current passes through an electromagnet. This creates a magnetic field that causes a piece of metal to be attracted to an underlying metal plate, producing an audible sound. Alternatively, a light or buzzer may be used to create the visual needed to convey the message. Depending on the type of machine in use, the receiver may then send a return message along the same wire to the original sender.

The code used to send messages via a telegraph was developed by Samuel Morse. Morse devised combinations of dots, dashes and spaces to represent letters, numbers and punctuation. The length of the signal determined whether a dot or dash was received. The length of space heard between dots and dashes determined if the following code was part of the same or a different word.

During the war, telegraphs were used to communicate across the trenches and between towns, cities and nations. While telegraphs allowed those involved in the war to receive crucial information about the movement of soldiers and battle outcomes, the wires used to operate the machines were frequently damaged or destroyed as a result of intense artillery fire.

In this activity, students apply their understanding of the physical sciences to construct a telegraph machine. Detailed step-by-step instructions can be seen below. It is recommended that use these instructions to guide your students through the scientific investigation.

1. Focus students' attention on the telegraph image featured within the previous activity. Explore what students already know about telegraph machines, including how these machines work. A KWL Chart could be completed with the class group to record ideas and thoughts shared during this time.

2. Inform students of their next challenge, which is to construct a simple telegraph machine from a circuit diagram. Students should work in groups of two to complete this challenge. Provide students with time to view and interpret the circuit diagram before they begin constructing their telegraph machine. Students may be provided with a variety of materials to construct the telegraph machine. These could include:
   - 9V batteries
   - Thumb tacks
   - Paper clips, various sizes
   - Aluminium foil
   - Bendable non-magnetic metal, such as cut up roasting trays or soft drink cans

     Teacher preparation: The metal that is chosen should be pre-cut to varied lengths and widths. Corners should be rounded to reduce likelihood of injury. You may decide that students can trim metal pieces themselves, in which case students should be supervised by an adult. They should also exercise care and control while completing this task.

   - Balsa wood, 1cm thick

     Teacher preparation: Balsa wood should be pre-cut to varied lengths. Pieces of balsa wood should be at least 10cm long.

   - Box cardboard
   - Insulated wire cables

     Teacher preparation: Wire cable should be pre-cut to varied lengths, with some lengths much longer than others to allow for the development of a telegraph machine that can transmit messages around corners to multiple people. Approximately 1.5 cm of insulation should also be removed from both ends of wire cable. A wire stripper, utility knife or sand paper could be used to assist in the completion of this task.

   - Electric buzzers or LED lights
   - Electrical tape
   - Scissors

   Students complete an investigation sheet (see below) to document the development of their telegraph machine and their engagement with the scientific inquiry process.

3. Following the completion of the telegraph machines, ask students to consider how they might go about sending a message to another person using this device, considering written words cannot be seen and spoken words cannot be heard. If not already identified by students, introduce the idea of a code, a system of rules used to convert information, such as a letters, numbers or punctuation, into another form or representation.

   Inform students that the code used to send messages via a telegraph was developed by Samuel Morse. Morse devised combinations of dots, dashes and spaces to represent letters, numbers and punctuation. Students could view the International Morse Code infographic included within this resource as this information is explained.

The length of the signal determines whether a dot or dash is received, with the duration of a dash being three times longer than a dot. The length of space heard between dots and dashes determines if the following code is part of the same or a different word; dots and dashes within the same word are separated by a space equal to three dots; while words are separated by a space equal to seven dots.

Before continuing, ask the class to determine the approximate signal length of one dot (i.e. half a second, one second, two seconds etc.), which will then be used to determine the signal length of dashes and the spaces between individual letters from the same word and different words. You may wish to use timer to help demonstrate signal lengths for dots and dashes. The chosen signal length should be used by all students for the remainder of this activity and the following activity.

4. Students encode the message they devised at the end of the periscope activity using Morse code. Provide students with time to practice sending and receiving this message using their telegraph machines.

5. Introduce students to the next challenge, which is to investigate how they could send messages to more than one person using their telegraph machine. Provide students with time to respond to this challenge. If desired, student groups could present how they completed the challenge to the class.

Curriculum Links

Science

YEAR 6

Science Understanding

Electrical energy can be transferred and transformed in electrical circuits and can be generated from a range of sources (ACSSU097)

Science as a Human Endeavour

Scientific knowledge is used to solve problems and inform personal and community decisions (ACSHE100)

Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena and reflects historical and cultural contributions (ACSHE098)

Science Inquiry Skills

With guidance, pose clarifying questions and make predictions about scientific investigations (ACSIS232)

Identify, plan and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying potential risks (ACSIS103)

Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate (ACSIS107)

Compare data with predictions and use as evidence in developing explanations (ACSIS221)

Reflect on and suggest improvements to scientific investigations (ACSIS108)

Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts (ACSIS110)

YEAR 8

Science Understanding

Energy appears in different forms, including movement (kinetic energy), heat and potential energy, and energy transformations and transfers cause change within systems (ACSSU155)

Science as a Human Endeavour

Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures (ACSHE226)

People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity (ACSHE136)

Science Inquiry Skills

Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS139)

Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS140)

Measure and control variables, select equipment appropriate to the task and collect data with accuracy (ACSIS141)

Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate (ACSIS144)

Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence (ACSIS145)

Reflect on scientific investigations including evaluating the quality of the data collected, and identifying improvements (ACSIS146)

Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate (ACSIS148)

Design and Technology

YEAR 6

Design and Technologies: Knowledge and Understanding

Investigate how electrical energy can control movement, sound or light in a designed product or system (ACTDEK020)

Design and Technologies: Processes and Production Skills

Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions (ACTDEP024)

Generate, develop and communicate design ideas and processes for audiences using appropriate technical terms and graphical representation techniques (ACTDEP025)

Select appropriate materials, components, tools, equipment and techniques and apply safe procedures to make designed solutions (ACTDEP026)

General Capabilities

Literacy

Comprehending texts through listening, reading and viewing

Composing texts through speaking, writing and creating

Visual knowledge

ICT Capability

Investigating with ICT

Critical and Creative Thinking

Inquiring: Identifying, exploring and organising information and ideas

Generating ideas, possibilities and actions

Reflecting on thinking and processes

Analysing, synthesising and evaluating reasoning and procedures

Personal and Social Capability

Self-management

Social management

Construct a Telegraph Machine

Student Activity

Objective

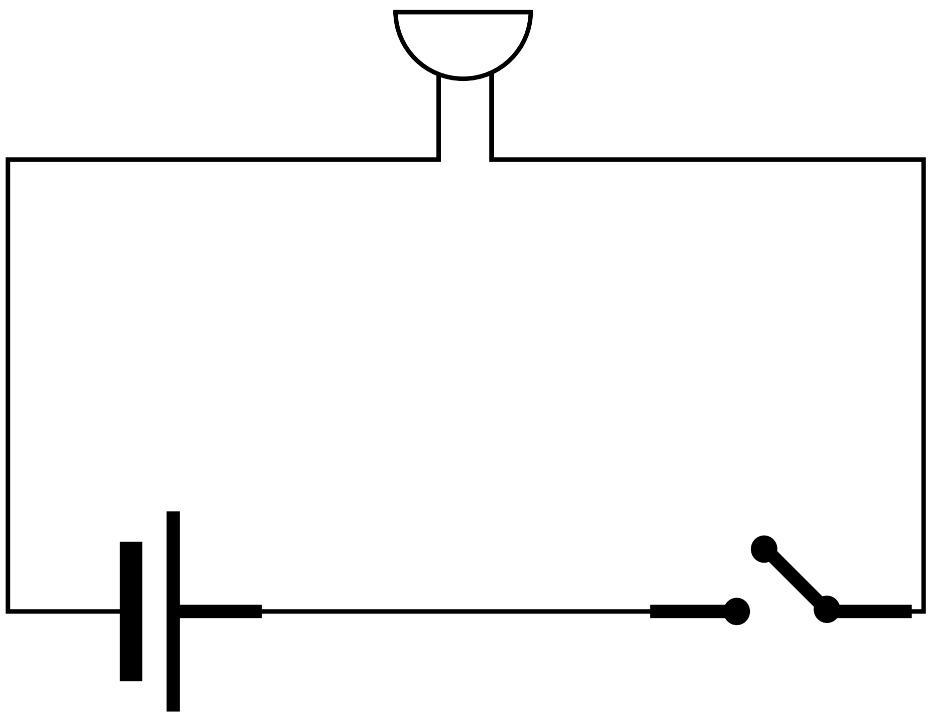
To construct a simple telegraph machine from a circuit diagram.

Materials

As provided by your teacher.

Activity

1. View the following circuit diagram of a simple telegraph machine. You will use this circuit diagram to construct your own telegraph machine. Label the symbols used to represent the components of the telegraph machine in the below circuit diagram



2. View the materials that are available to construct the telegraph machine. Determine which materials you will use to make the telegraph based on the circuit diagram. Write down which materials you will use and draw a labelled diagram to show how you will construct the telegraph using these materials. Explain why you think this will work.

Materials What will you use to make the telegraph?	
Predict Draw a labelled diagram to show how you could construct the telegraph using these materials.	
Reason Why do you think this will work? Discuss type and use of materials in your response.	

3. Before constructing your telegraph machine, discuss any potential safety hazards with your group. Record these hazards and the actions your group will take to ensure this is a safe investigation.

4. Construct and test your telegraph machine. Record and explain your observations.

Observe What happened? What did you see?	
Explain Why did this happen? Did your results support your prediction? Why?	

5. Draw an energy flow diagram of the energy transformations that occur in the device.

6. Use Morse code to send a message about a threat such as an approaching tank to your supervisors. You can record this message and/or encode it in the space below.

Practice sending and receiving this message with your group. How quickly can you send a message? How quickly can your team members decode your message?

7. How could you send a message to more than one person using your telegraph machine? Discuss this question with your team members. Draw a circuit diagram to show how you will construct the telegraph using these materials and explain why you think this will work.

Materials What will you use to make the telegraph?	

Predict Draw a circuit diagram to show how you could construct the telegraph using these materials.	
Reason Why do you think this will work? Discuss type and use of materials in your response.	

8. Construct and test your telegraph machine. Record and explain your observations.

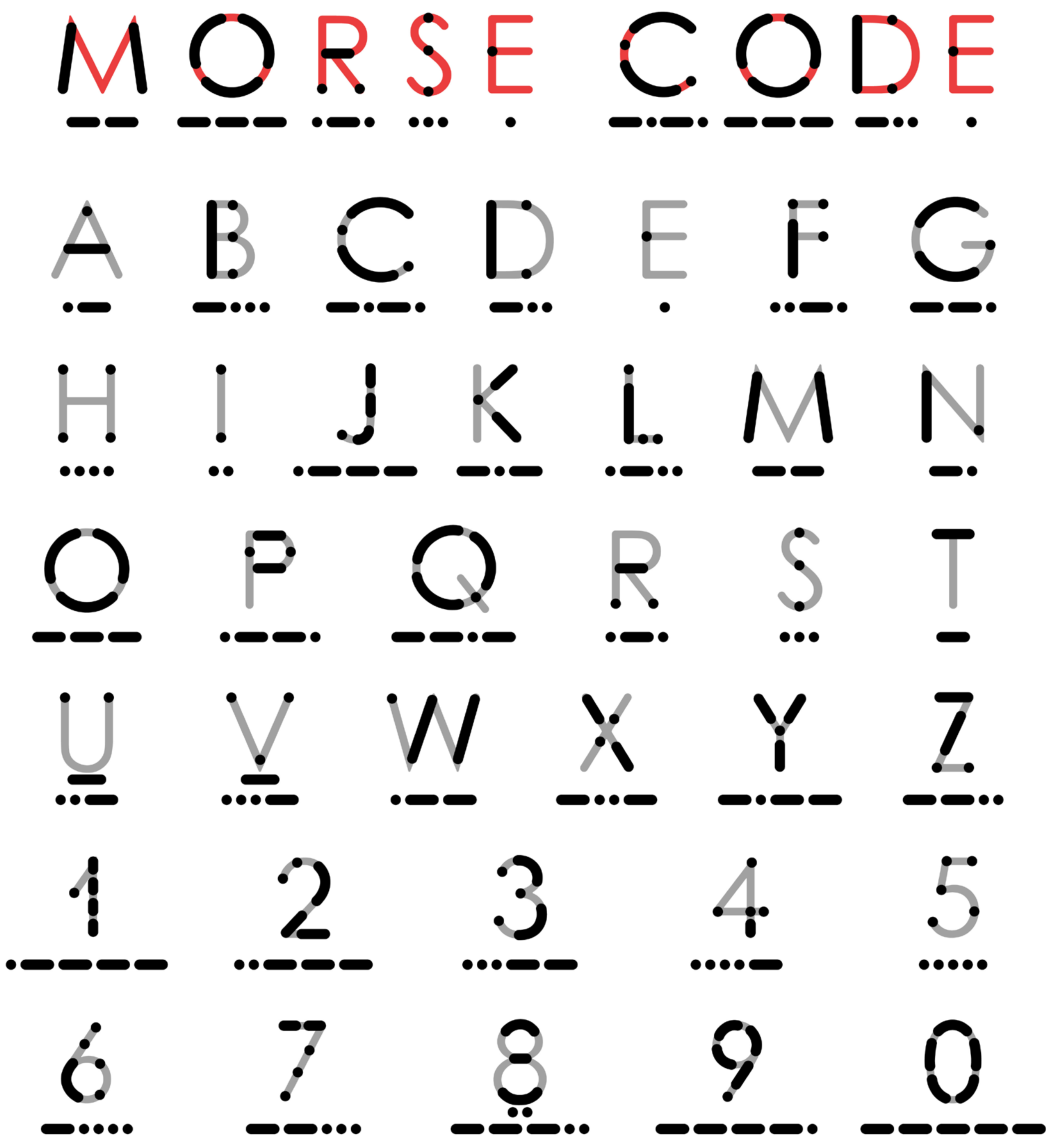
Observe What happened? What did you see?	

Explain Why did this happen? Did your results support your prediction? Why?	

9. What could you do to improve the telegraph? Why will you make these changes?

Draw a labelled diagram to show these improvements.

10. Test your revised design. Describe how these changes did or did not improve the telegraph machine.



Activity 3: Coded Messages

Teacher Resource

In this activity, students investigate how they can use ciphers to keep confidential information from prying eyes. In cryptography (from the Greek *kryptos* for hidden and *graphia* for writing), ciphers are used to encrypt and decrypt messages. Ciphers use algorithms, set processes or series of rules that must be followed in order to solve a problem, to mix up or substitute individual letters within a message with other letters or symbols. For a cipher to be useful, the sender and receiver must know the:

- Algorithm used to encipher the original message, also known as 'plaintext'.
- Key used with the algorithm to encipher and decipher the plaintext.
- Period of time for which the key is valid.

Ciphers were used extensively during the First World War and varied in complexity, depending on the nature of the message to be sent. Students will explore two types of ciphers within this activity, a substitution and a transcription cipher, and associated methods of decryption. Detailed step-by-step instructions can be seen below. It is recommended that you use these instructions to guide your students through the activity.

1. Review the positive, negative and interesting implications students recorded for the telegraph machine in Activity 1. Provide students with time to add to their initial responses before sharing as a class group. Ask students to discuss the positive, negative and interesting implications of using Morse code to send and receive messages, especially those of a sensitive nature. Students brainstorm how they could reduce or eliminate the discussed negative implications. If students have not already raised the idea by this time, suggest the possible interception of messages by the enemy, and how the enemy may use these messages to their advantage.
2. Focus on the interception of messages by the enemy. If students have not already raised the idea by this time, discuss the use of encrypted messages to keep the information contained in messages secret. Note that there are many different ways to encrypt a message; these can include the use of ciphers. Discuss what a cipher is with students, and how a cipher is different to a code (a cipher mixes up or substitutes individual letters within a message with other letters or symbols, while a code replaces whole words in a message with different words). Students will investigate how they can encrypt (write) and decrypt (decode/read) a substitution and a transcription cipher.
3. Devise a message for students to encrypt, or ask students to think of a short message that could be encrypted as a class group. This message could be:

   CODING IS AWESOME

   Introduce the first cipher, a Caesar cipher, which is an example of a substitution cipher. The Caesar cipher is one of the earliest known and simplest ciphers to use; this also makes the cipher relatively easy to break. The Caesar cipher was named after the Roman emperor, Julius Caesar, who used this encryption method to communicate with his generals. In order to use this cipher, each letter of the alphabet is replaced by a letter some fixed number of positions further down the alphabet. To start, a fixed number between 1 and 26 is chosen. This, for example, could be the number four. Each letter of the message is then replaced with the letter four places down the alphabet. Students could also use a cipher wheel to assist in the completion of this task.

The previous message would then read as:

GSHMRK MW EAIWSQI

Ask students: What else could be done to make this message more difficult o decode? Methods could include changing where the spaces are in the message. Provide students with an opportunity to encrypt their own short messages using the Caesar cipher.

Display a new Caesar cipher for the class to analyse. The message should be one developed by the teacher, to allow for students to explore decryption methods and 'break' the cipher. Ask students how they could go about decrypting the cipher when they do not know the key. This discussion could occur as a class or in small groups. While various methods may be explored, one of the most common decryption methods for this cipher is trial and error, whereby students test each shift in turn, moving letters back by fixed numbers until the message appears.

Students could also explore the process of 'frequency analysis' to decrypt messages. Frequency analysis is the study of the distribution of letters in a text. Every language uses some letters more often than others. Frequency analysis exploits these patterns by comparing letter frequencies in a plain text message with letter frequencies in an encrypted message. The average letter frequencies in the English language are as follows:

E	12.7%	**T**	9.1%	**A**	8.2%	**O**	7.5%
I	7.0%	**N**	6.7%	**S**	6.3%	**H**	6.1%
R	6.0%	**D**	4.3%	**L**	4.0%	**C**	2.8%
U	2.8%	**M**	2.4%	**W**	2.4%	**F**	2.2%
G	2.0%	**Y**	2.0%	**P**	1.9%	**B**	1.5%
V	1.0%	**K**	0.8%	**J**	0.2%	**X**	0.2%
Q	0.1%	**Z**	0.1%				

Using this information, it could then be assumed the letter that appears the most frequently in an encrypted message will translate to 'e'. The next letter that appears most frequently is then likely to translate to 't' or 'a' and so on. Frequency analysis generally only applies to longer encrypted messages for the frequencies to be statistically significant. Consequently, this method should be used to decrypt messages that are at least one paragraph in length.

Students could practise applying this method when working to decrypt longer messages encrypted with a Caesar cipher, such as the diary entry of Alan Dodd (see Student Activity). Firstly, students could work together to calculate letter frequencies, working with a page of text from a book or a webpage from the internet to complete this task. Students could then display collected data in a table and graph, and compare their results with other groups. Alternatively, students could use the data presented in the previous letter frequency table to assist with the decryption of messages. They then use the frequency analysis to decrypt the message by:

- Identifying the total number of characters in the message.
- Tallying how many times each encrypted letter appears in the message.
- Converting encrypted letter totals to a percentage.
- Comparing this data to the frequency analysis percentages to decrypt letters.

After exploring one or both of the above methods, students can practise sending, receiving and decrypting previously devised messages using Morse code and their telegraph machines.

4. Devise a second message for students to encrypt, or ask students to think of a short message that could be encrypted as a class group. This message could be:

   SCIENCE IS AWESOME

   Introduce the next cipher, a transposition cipher, which is an example of a transcription cipher. A transposition cipher rearranges the order of the letters in the plaintext according to some predetermined method without making any letter substitutions. In order to use this cipher, each letter of the alphabet is organised into a grid, moving from left to right. The grid may be any dimension. The above message then might look something like this:

S	C	I	E
N	C	E	I
S	A	W	E
S	O	M	E

   A ‘padding character’ such as the letter ‘X’ would be added to any boxes that are not filled by the original message.

   The message is then encrypted by reading the letters in order down the columns, starting from the left hand side. If using the above example, the encrypted message would read as:

   SNSS CCAO IEWM EIEE

   Ask students: What else could be done to make this message more difficult o decode? Methods could include changing where the spaces are in the message. Provide students with an opportunity to encrypt their own messages using the transposition cipher.

Display a new transposition cipher for the class to analyse. The message should be one developed by the teacher, to allow for students to explore decryption methods and 'break' the cipher. Ask students how they could go about decrypting the cipher when they do not know the key. This discussion could occur as a class or in small groups. While various methods may be explored, the following process may be explored with students:

- Identify the total number of characters in the encrypted message.

  E.g. In the previous example there are 16 characters.

- Identify the combination of grid dimensions that this number of characters could completely fill.

  E.g. With 16 characters, the combination of grid dimensions used to encrypt the message could be 1 x 16, 2 x 8, 4 x 4, 8 x 2, 16 x 1

- Test placing the encrypted message into each of these combinations, working down and across the columns, starting from the right hand side. Students may find it useful to work from grid paper during this time. The encrypted message is broken when, reading from left to right from the first row, all letters combine to form understandable words.

  E.g. A 1 x 16 grid does not rearrange the message at all.

  A 2 x 8 grid gives:

S	S	C	A	I	W	E	E
N	S	C	O	E	M	I	E

  SSCAIWEENSCOEMIE

  The letters do not combine to form understandable words.

  A 4 x 4 grid gives:

S	C	I	E
N	C	E	I
S	A	W	E
S	O	M	E

  SCIENCEISAWESOME

  With the addition of spaces, the letters combine to form understandable words.

  The cipher is broken.

  Following this, students can swap their previously encrypted messages with a peer to practise decryption. Students can practise sending, receiving and decrypting these messages using Morse code and their telegraph machines.

  Following this activity, you may also like to encourage students to reflect on how they and others keep important messages or information safe today.

Curriculum Links

Mathematics

YEAR 5

Number and Algebra

Identify and describe factors and multiples of whole numbers and use them to solve problems (ACMNA098)

Use efficient men al and written strategies and apply appropriate digital technologies to solve problems (ACMNA291)

Statistics and Probability

Pose questions and collect categorical or numerical data by observation or survey (ACMSP118)

Construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies (ACMSP119)

Describe and interpret different data sets in context (ACMSP120)

YEAR 6

Number and Algebra

Select and apply efficient men al and written strategies and appropriate digital technologies to solve problems involving all four operations with whole numbers (ACMNA123)

Find a simple fraction of a quantity where the result is a whole number, with and without digital technologies (ACMNA127)

Make connections between equivalent fractions, decimals and percentages (ACMNA131)

Statistics and Probability

Interpret and compare a range of data displays, including side-by-side column graphs for two categorical variables (ACMSP147)

YEAR 7

Number and Algebra

Round decimals to a specified number of decimal places (ACMNA156)

Connect fractions, decimals and percentages and carry out simple conversions (ACMNA157)

Statistics and Probability

Calculate mean, median, mode and range for sets of data. Interpret these statistics in the context of data (ACMSP171)

Describe and interpret data displays using median, mean and range (ACMSP172)

YEAR 8

Number and Algebra

Investigate terminating and recurring decimals (ACMNA184)

General Capabilities

Numeracy

Estimating and calculating with whole numbers

Recognise and using patterns and relationships

Using fractions, decimals, percentages, ratios and rates

Interpreting statistical information

Critical and Creative Thinking

Inquiring: Identifying, exploring and organising information and ideas

Generating ideas, possibilities and actions

Reflecting on thinking and processes

Analysing, synthesising and evaluating reasoning and procedures

Activity 3: Coded Messages

Teacher Answers

Diary Entry of Alan Dodd

This is American Independence Day; a fair number of Yanks are round here, they ought to make splendid fighters, fresh and eager unlike the war weary troops [illegible words]. Their choice of language is not so [illegible word] as the [illegible word]. “God damn” repeated at very frequent intervals being the chief expression.

Friday, July 5

Fritz had his night out last night. Heard more bombs dropt [sic] than have since [illegible word] days. It is strange how bombs “put the wind up” the boys. As someone said, “When you hear the first of Fritzs engine directly overhead you sort of feel that yours is the only hut or tent in the world and you the only inhabitant.” Yes as tho [sic] the fates had taken control of the law of gravitation and then invisible hands were drawing the missiles to one’s destruction.

Saturday and Sunday, July 6 and 7

Up at Windy Ridge again tonight. Quiet enough at first trip at 12.30am, after leaving the ridge and nearly at the foot of the hill, we could notice gas shells bursting in numbers just ahead of us; caught one whiff, then ran into a thick cloud if it. Put our gas masks on at the [illegible word], and drove on thru [sic] the village with [illegible word] gas shells and HE [high explosives] coming thick and fast. At the [illegible word] stuff as flying in all directions and we unloaded our patients hurriedly and waited in the 20 foot deep dugout. Several hits on the dugout but after an hour things quietened down. Made two more trips with masks on; on the last with a full load on nearly upset the car, the wheels went over the edge of a shell hole but held at precarious angle; unloaded our patient onto the Sunbeam car and willing helpers soon righted the bus. Quiet enough through the day. Relieved at 6.30pm and back home. A bit of excitement is stimulating – after it’s over, one feels the zest of the thing.

Monday July 8

Warm today, a storm gathered in the evening but [illegible word] to [illegible word] and only a few drops falling.

Activity 3: Coded Messages

Student Activity

Caesar Cipher

A Caesar cipher is an example of a substitution cipher. The Caesar cipher was named after the Roman emperor, Julius Caesar, who used this encryption method to communicate with his generals. To use this cipher, each letter is replaced by a different letter some fixed positions, or shifts, further down the alphabet. While the Caesar cipher is one of the earliest known and simplest ciphers to use, it is also one of the easiest to break.

A Caesar cipher has been used to encrypt the following message. Apply the frequency analysis method to 'break' the cipher and read the message.

Activity

1. Count the total number of letters in the message. Record this number in the table on the following page.
2. Tally how many times each encrypted letter appears in the message. You may need to attach additional paper if you run out of space in the table.
3. Calculate the letter frequency for each encrypted letter. Record this as a percentage of the total letters.
4. Compare this percentage with the percentages included in the frequency analysis table below to decrypt the letters. Use this information to decrypt the message.
5. Finally, identify the letter shift used to encrypt the message.

Frequency Analysis Table

E	12.7%	**T**	9.1%	**A**	8.2%
O	7.5%	**I**	7.0%	**N**	6.7%
S	6.3%	**H**	6.1%	**R**	6.0%
D	4.3%	**L**	4.0%	**C**	2.8%
U	2.8%	**M**	2.4%	**W**	2.4%
F	2.2%	**G**	2.0%	**Y**	2.0%
P	1.9%	**B**	1.5%	**V**	1.0%
K	0.8%	**J**	0.2%	**X**	0.2%
Q	0.1%	**Z**	0.1%		

Encrypted Message

ftue ue myqduomz uzpqbqzpqzoq pmk; m rmud zgynqd ar kmzwe mdq dagzp tqdq, ftqk agstf fa ymwq ebxqzpup rustfqde, rdqet mzp qmsqd gzxuwq ftq imd iqmdk fdaabe [uxxqsunxq iadpe]. ftqud otauoq ar xmzsgmsq ue zaf ea [uxxqsunxq iadp] me ftq [uxxqsunxq iadp]. “sap pmyz” dqbqmfqp mf hqdk rdqcgqzf uzfqdhmxe nquzs ftq otuqr qjbdqeeuaz.

rdupmk, vgxk 5
rdufl tmp tue zustf agf xmef zustf. tqmdp yadq nayne pdabf ftmz tmhq euzoq [uxxqsunxq iadp] pmke. uf ue efdmzsq tai nayne “bgf ftq iuzp gb” ftq nake. me eayqazq emup, “itqz kag tqmd ftq rudef ar rdufle qzsuzq pudqofxk ahqdtqmp kag eadf ar rqqx ftmf kagde ue ftq azxk tgf ad fqzf uz ftq iadxp mzp kag ftq azxk uztmnufmzf.” kqe me fta ftq rmfqe tmp fmwqz oazfdax ar ftq xmi ar sdmhufmfuaz mzp ftqz uzhueunxq tmzpe iqdq pdmiuzs ftq yueeuxqe fa azq’e pqefdgofuaz.

emfgdpmk mzp egzpmk, vgxk 6 mzp 7
gb mf iuzpk dupsq msmuz fazustf. cguqf qzagst mf rudef fdub mf 12.30my, mrfqd xqmhuzs ftq dupsq mzp zqmdxk mf ftq raaf ar ftq tuxx, iq oagxp zafuoq sme etqxxe ngdefuzs uz zgynqde vgef mtqmp ar ge; omgstf azq iturr, ftqz dmz uzfa m ftuow oxagp ur uf. bgf agd sme ymewe az mf ftq [uxxqsunxq iadp], mzp pdahq az ftdg ftq huxxmsq iuft [uxxqsunxq iadp] sme etqxxe mzp tq [tust qjbxaeuhqe] oayuzs ftuow mzp rmef. mf ftq [uxxqsunxq iadp] efgrr ime rxkuzs uz mxx pudqofuaze mzp iq gzxampqp agd bmfuqzfe tgdduqpxk mzp imufqp uz ftq 20 raaf pqqb pgsagf. eqhqdmx tufe az ftq pgsagf ngf mrfqd mz tagd ftuzse cguqfqzqp paiz. ympq fia yadq fdube iuft ymewe az; az ftq xmef iuft m rgxx xamp az zqmdxk gbeqf ftq omd, ftq itqqxe iqzf ahqd ftq qpsq ar m etqxx taxq ngf tqxp mf bdqomduage mzsxq; gzxampqp agd bmfuqzf azfa ftq egznqmy omd mzp iuxxuzs tqxbqde eaaz dustfqp ftq nge. cguqf qzagst ftdagst ftq pmk. dqxuqhqp mf 6.30by mzp nmow tayq. m nuf ar qjoufqyqzf ue efuygxmfuzs – mrfqd uf’e ahqd, azq rqqxe ftq lqef ar ftq ftuzs.

yazpmk vgxk 8
imdy fapmk, m efady smftqdqp uz ftq qhqzuzs ngf [uxxqsunxq iadp] fa [uxxqsunxq iadp] mzp azxk m rqi pdabe rmxxuzs.

Coded Messages: Break The Cipher!

Total Number of Letters

Encrypted Letter	Tally	Total Number of Letters	Percentage	Actual Letter
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				
K				
L				
M				
N				
O				
P				
Q				
R				
S				
T				
U				
V				
W				
X				
Y				
Z				

Alan Dodd

The message you decrypted is actually a diary entry written by Alan Dodd. Dodd was a budding 20-year-old entomologist when he enlisted in the Australian Army in February 1916. His father was Frederick Dodd, a well-known naturalist nicknamed 'the Butterfly man of Kuranda'. You can view the insects collected by Frederick and Alan Dodd at ***Queensland Museum's Google Arts and Culture*** webpage, including the:

- ***King stag beetle case***
- ***Ulysses butterfly case***
- ***New Guinea jezebel butterfly case***

As a boy, Alan had been involved in the family business of collecting and preserving insects for sale worldwide. He had published 12 papers in Australian and European scientific journals by the age of 19, and was working in research with the Queensland Bureau of Sugar Experimental Station at Gordonvale when he enlisted.

Alan left Australia in July 1917 and served as a medical orderly with the 15th Field Ambulance in France. He kept a meticulous record of his war service in three small, covered notebooks, documenting the weather, the landscape, and his, sometimes harrowing, experiences with his unit.

Cipher Wheel